Course:
Energy and Resource Efficiency (BAE 4174)
2 SWS, 3 credits,
Wednesday 15:30 – 18:45 only the introductory lesson is finished at 17.00
Room: Virtuell within the web-tool “Alpha View”

Instructor:
Dipl.-Ing. Dipl.-Ing. (FH) Jens Buchgeister; E-Mail: jens.buchgeister@kit.edu

(For more details**:** https://www.hs-pforzheim.de/De-de/Technik/Wirtschaftsingenieurwesen/Wirtschaftsingenieur-wesen/Studierende/Kurskatalog_GM/Seiten/Kurskatalog.aspx?kennung=BAE4174

Your education is important to me, therefore I would like to support you. Please feel free to contact me via email if you have any questions or problems regarding the course. I will respond as soon as possible and if necessary make an appointment with you.
E-Mail: jens.buchgeister@kit.edu (preferred communication)

Overview:
The climate change in conjunction with a high consumption of energy in all sectors (power supply, mobility, heating, private and governmental households,) comprises new challenges and requirements for companies, governments and citizens. All these actors of a society are responsible to develop a procedure including an economy which fulfils the Earth's life-sustaining capacity. In front of this background the course deliver insights from a holistic system perspective on the energy system, their different subsystems and actors. Starting with basic principles on energy demand, what are drivers for them, interpretation on national energy balance followed by methodology background on sustainability, what does it means for a modern society it will be shown the role of energy and resource efficiency as part of a sustainability assessment.
The holistic system perspective on the energy system will be supplemented by student team projects on the following energy topics:

- Energy transition in Germany (Team 1)
- Phase out of Coal Power Supply in Germany (Team 2)
- Energy efficient Production and use of Goods (Team 3)
- Lightweight design as a driver of innovation: improving energy efficiency and emissions of GHG (Team 4)
- Innovative techniques in production, distribution or transport of energy (Team 5)

Learning Objectives:

Course Topics:

I. Introductory meeting
- Presenting and discussing the topics of the lecture and topic assignment to each team of students

II. System approach: Energy and Resource Efficiency – What are the drivers? How can it be measure?

III. Energy - From a global perspective to applications in industry

IV. Team 1: Energy transition in Germany

Literature:

- VDI Guideline 4800 Part 1 Resource efficiency - Methodological principles and strategies, Düsseldorf, Feb. 2016
- Billinton, Roy; Karki, Rajesh; Verma, Ajit Kumar; Editors; “Reliability and Risk Evaluation of Wind Integrated Power Systems”, Springer India 2013.
- Keil, Jan; “The German Energy Transition – Issues and Perspectives”, 2012.
- Quaschning, V.; „Regenerative Energiesysteme, Technologie – Berechnung – Simulation“, Carl Hanser Verlag, München, 2015.
- Quaschning, V.; „Erneuerbare Energien und Klimaschutz“, Carl Hanser Verlag, München, 2018
- Shmelev, Stanislav E.; “Ecological Economics: Sustainability in Practice”, Springer Netherlands 2012.
- Chancen für die deutsche Energiewende – Was kann Deutschland aus ausgewählten internationalen Fallbeispielen lernen? Mckinsey studie Chancen für die deutsche Energiewende
- “An Ambitious Triple Target for 2030”; Comment to the Commission’s Green Paper; A 2030 Framework for Climate and Energy Policies (COM(2013) 169 final); in: Comment on Environmental Policy No. 12; June 2013
- ***Internet:***
- http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf
- https://www.destatis.de/DE/Publikationen/Thematisch/UmweltoekonomischeGesamtrechnungen/Umweltindikatoren/IndikatorenPDF_0230001.pdf?__blob=publicationFile
- http://www.faz.net/aktuell/wirtschaft/energiewende-zu-viel-ist-zu-viel-12573007.html
- http://www.spiegel.de/international/germany/doubts-increasing-about-germany-s-switch-to-renewable-energy-a-844844.html

- http://www.faz.net/aktuell/wirtschaft/wirtschaftspolitik/energiepolitik/energiewende-darum-geht-es-in-der-debatte-um-die-eeg-reform-12606587.html

- http://www.faz.net/aktuell/wirtschaft/wirtschaftspolitik/energiepolitik/energiewende-doppelter-angriff-auf-deutsche-oekostromhilfe-12606339.html

- http://ec.europa.eu/energy/green_paper_2030_en.htm

- http://ec.europa.eu/energy/renewables/reports/reports_en.htm

V. Team 2: Phase out of Coal Power Supply in Germany

Literature:

- Hermann, H.; Greiner, B.; Matthes, F.; Cook, V.: "Die deutsche Braunkohlenwirtschaft. Historische Entwicklungen, Ressourcen, Technik, wirtschaftliche Strukturen und Umweltauswirkungen", im Auftrag Agora Energiewende, 5/2017, https://www.agora-energiewende.de/fileadmin2/Projekte/2017/Deutsche_Braunkohlenwirtschaft/Agora_Die-deutsche-Braunkohlenwirtschaft_WEB.pdf

- Sachverständigenrat für Umweltfragen (SRU): „Kohleausstieg jetzt einleiten". Stellungnahme, Okt. 2017, https://www.umweltrat.de/SharedDocs/Downloads/DE/04_Stellungnahmen/2016_2020/2017_10_Stellungnahme_Kohleausstieg.pdf?__blob=publicationFile&v=19

- WWF-Studie: „Zukunft Stromsystem – Kohleausstieg 2035", 1/2017, https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/WWF-Studie-Stromsystem-Kohleausstieg2035.pdf

- Deutscher Bundestag Drucksache 19/2575: Kleine Anfrage der Linken - Zukunft und Begünstigungen der Braunkohlewirtschaft in Deutschland, 1. Juni 2018, http://dip21.bundestag.de/dip21/btd/19/025/1902575.pdf

- ***Internet:***

- https://www.umweltbundesamt.de/bild/kraftwerke-verbundnetze-in-deutschland, Stand: März 2018

- http://www.spiegel.de/wirtschaft/unternehmen/braunkohlewirtschaft-bietet-nur-noch-20-000-arbeitsplaetze-a-1155782.html

- Datenbank Kraftwerke in D, https://www.umweltbundesamt.de/sites/default/files/medien/372/dokumente/kraftwerke_de_ab_100_mw.xls

VI. Team 3: Energy efficient Production and use of goods

Literature:

- Danny Harvey, L.D.; "Energy efficiency and the demand for energy services", London/Washington D.C. 2013.

- Fleiter et al: Adoption of energy-efficiency measures in SMEs – an empirical analysis based on energy audit data. ECEE summer 2012, p. 723-732

- International Energy Agency: Energy Efficiency 2017. OECD/IEA, 2017. www.iea.org

- Pehnt, Martin; „Energieeffizienz – Ein Lehr- und Handbuch"; Wiesbaden: Springer. 2010.

Internet:

- Fraunhofer Gesellschaft; „ Energieeffizienz in der Produktion - Untersuchung zum Handlungs- und Forschungsbedarf"; 2008. http://www.fraunhofer.de/content/dam/zv/de/forschungsthemen/energie/Studie_Energieeffizienz-in-der-Produktion.pdf

- DENA: Initiative Energieeffizienz; http://www.energieeffizienz-online.info/rechtliche-rahmenbedingungen/energieeffizienz-richtlinien.html

- http://www.greencarcongress.com/2011/06/lowcvp-20110608.html

- Re-engineering Manufacturing for Sustainability; http://link.springer.com/book/10.1007/978-981-4451-48-2

- Managing Eco Design and Sustainable Manufacturing; http://link.springer.com/chapter/10.1007/978-981-4451-48-2_10

- Beginning Application Lifecycle Management; http://www.springer.com/computer/book/978-1-4302-5812-4

VII. Team 4: Lightweight design as a driver of innovation: improving energy efficiency and emissions of GHG

Literature:

- Marscheider-Weidemann et al: „Rohstoffe für Zukunftstechnologien 2016" Vortrag, Deutsche Rohstoffagentur in der BGR

- Danny Harvey, L.D.; "Energy efficiency and the demand for energy services", London/Washington D.C. 2013.

- Ehrenberger, S.; Schmid, S.: Life-Cycle-Assessment als Entscheidungshilfe für Leichtbau. In: H. E. Friedrich; „Leichtbau in der Fahrzeugtechnik", Wiesbaden: Springer. 2013.

- Ehrenberger, S.; Schmid, S.: Knöfel, S.; Schüler-Hainsch; „Leichtbau im End-of-Life Konzept", in: H. E. Friedrich; „Leichtbau in der Fahrzeugtechnik", Wiesbaden: Springer Fachmedien; 2013.

- Eichlseder, W., ; Schöneburg, R. ;"Anforderungen an den Leichtbau im Fahrzeug", in: H. E. Friedrich; „Leichtbau in der Fahrzeugtechnik", Wiesbaden: Springer Fachmedien; 2013.

- Ellenrieder, G.; Gänsicke, T.; Goede, M.; Herrmann, H. G.; „Die Leichtbaustrategien“, in: H. E. Friedrich; „Leichtbau in der Fahrzeugtechnik“, Wiesbaden: Springer Fachmedien; 2013.

- Gänsicke, T.; Goede, M.; “Technische Motivation”. in: H. E. Friedrich; „Leichtbau in der Fahrzeugtechnik“, Wiesbaden: Springer Fachmedien; 2013.

- Knöfel, S.; Schüler-Hainsch, E.; „Verfügbarkeit von Rohstoffen für automobilen Leichtbau“, in: H. E. Friedrich; „Leichtbau in der Fahrzeugtechnik“, Wiesbaden: Springer Fachmedien; 2013.

- Krinke, S.; Koffler, Ch.; Deinzer, G.; Heil, U.; „Automobiler Leichtbau unter Einbezug des gesamten Lebenszyklus“. ATZ, Automobiletechnik Zeitschrift 112; 2010.

- Herring, Horace; “Technological innovation, energy efficient design and the rebound effect” in: Design Innovation Group, Faculty of Technology, The Open University, Milton Keynes MK7 6AA, UK ; Technovation, Volume 27, Issue 4, April 2007, pp. 194-203. http://www.sciencedirect.com/science/article/pii/S016649720600112X

- Journal Lightweight Design; http://www.springer.com/chemistry/journal/35725

- Günter Schuh et: Environmental impact of body lightweight design http://link.springer.com/chapter/10.1007%2F978-981-4451-48-2_17

VIII. Team 5: Innovative techniques in production, transport and storage of energy

Literature:

- Boguski, Terrie K.; “Life cycle carbon footprint of the National Geographic magazine”, in: The International Journal of Life Cycle Assessment, August 2010, Volume 15, Issue 7, pp. 635-643. http://link.springer.com/article/10.1007/s11367-010-0210-5#page-2

- Filho , Walter Leal; Mannke, Franziska; Mohee, Romeela; Schulte, Veronika; Surroop, Dinesh; Editors “Climate-Smart Technologies - Integrating Renewable Energy and Energy Efficiency in Mitigation and Adaptation Responses”, Berlin/Heidelberg 2013.

- Fuchs, Lunz, Leuthold, Sauer: Technologischer Überblick zur Speicherung von Elektrizität. Im Auftrag der Smart Energy for Europe Platform GmbH (SEFEP), Institut für Stromrichtertechnik und Elektrische Antriebe RWTH Aachen, 2012, http://www.sefep.eu/activities/projects-studies/Ueberblick_Speichertechnologien_SEFEP_deutsch.pdf or in English http://www.sefep.eu/activities/projects-studies/120628_Technology_Overview_Electricity_Storage_SEFEP_ISEA.pdf

- Hertwich, Edgar G.; Peters, Glen P.; “Carbon Footprint of Nations: A Global, Trade-Linked Analysis”, in: *Environ. Sci. Technol.*, 2009, 43 (16), pp. 6414–6420. http://pubs.acs.org/doi/abs/10.1021/es803496a

- Noam, Eli M.; Pupillo, Lorenzo Maria; Kranz, Johann J.; ‘‘Broadband Networks, Smart Grids and Climate Change”; Editors, New York 2013.

- Weidema, Bo P.: Thrane, Mikkel; Christensen, Per; Schmidt, Jannick; Løkke, Søren; “Carbon Footprint A Catalyst for Life Cycle Assessment?”, in: Journal of Industrial Ecology ,Volume 12, Issue 1, February 2008, pp. 3–6. http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2008.00005.x/full

- http://www.speichermonitoring.de/

Extra Literature:

- ISO - INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (2006a): Umweltmanagement - Ökobilanz - Grundsätze und Rahmenbedingungen (ISO 14040:2006), Genf, Schweiz.

- ISO - INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (2006b): Umweltmanagement - Ökobilanz –Anforderungen und Anleitungen (ISO 14044:2006), Genf, Schweiz.

- DIN ISO 14067 Treibhausgase - Carbon Footprint von Produkten - Anforderungen an und Leitlinien für Quantifizierung, Berlin, 2017.

- Wietschel, M. et al.: Energietechnologien 2050. Fraunhofer Verlag, Stuttgart, 2010.

- Poting et al: Input to the European Commission from European EPAs about monitoring progress of the transition towards a circular economy in the European Union. European Network of the Heads of Environment Protection Agencies (EPA Network) - Interest group on Green and Circular Economy, May 2017

- Moreau et al: Coming full Circle. Why Social and Institutional Dimensions Matter for the circular Economy. Journal of Industrial Ecology, Special Issue on exploring the Circular Economy, Vol. 21, No. 3, June 2017

- Huber, J.; „Global Change. Industrielle Ökonomie. Konsistenz, Effizienz, und Suffizienz in zyklischer Betrachtung“,. Baden-Baden: Nomos Verlag.2000.

- ***Internet:***

- http://www.iea.org/publications/freepublications/publication/name,38764,en.html

- http://www.iea.org/newsroomandevents/news/2013/september/name,42943,en.html

- http://www.energie.kit.edu/129%20Rahmenseite%20Intelligentes%20Energiemanagement.php

- Drehscheibe Nachhaltigkeit http://www.drehscheibe-nachhaltigkeit.de/index.html

- Umweltdialog: http://www.umweltdialog.de/umweltdialog/rubrikverteiler/index.php
- Weltwirtschaft und Entwicklung: http://www.weltwirtschaft-und-entwicklung.org/
- Wuppertal Institut: http://www.wupperinst.org/
- Oekom Verlag (für neue NE Literatur): http://www.oekom.de/
- http://www.worldenergyoutlook.org/
- http://www.umweltrat.de/

Contribution to program goals

	Learning Objective	Contribution
1.1	Students demonstrate key knowledge in Technical Basics.	Introduction to and communication of interdependencies between technical, business and environmental requirements
1.2	Students demonstrate key knowledge in Mechanical Engineering.	The principles of the most relevant thermal and electricity energy generation processes are discussed
1.3	Students demonstrate key knowledge in Business Administration.	Reading a wide variety of texts form business and technical journals and newspaper to gain an insight into diverse topics
1.4	Students demonstrate key knowledge in Economics.	Economic effects on projects are considered during project environment analysis
1.5	Students demonstrate key knowledge in Mathematics.	Laws of conservation of energy and mass are applied as mathematical basis for quantitative economic and environmental analysis of energy processes
1.6	Students demonstrate key knowledge in Quantitative Methods.	For the assessment of different technologies a quantitative economic and/or environmental analysis is carried out
1.7	Students demonstrate key knowledge in Computer Science.	Application of standard office software
2.1	Students demonstrate proficiency in using current computer programs to solve business and technical problems.	
2.2	Students demonstrate the ability to use information systems effectively in real world business settings.	Students will be encouraged to look up a variety of internet sources to research the various topics
3.	Students are able to apply analytical and critical thinking skills to complex problems.	Finding Solutions for problems on a scientific basis (specialization/application)
4.	Students are able to develop business ethics-based strategies and are able to apply them to typical business decision-making problems.	
5.1	Students demonstrate their ability to express complex issues in writing.	The results of a presented topic have to be documented scientifically and in detail
5.2	Students demonstrate their oral communication skills in presentations and lectures.	Role-plays, contributions to discussion of critical incidents/case studies. Presentations
6.	Students show that they are able to work successfully in a team by performing practical tasks.	Role plays, discussions in groups of 3-4 students. Class participation in discussions/role plays
7.	Students demonstrate their ability to develop and present complex interdisciplinary solutions by means of an application oriented assignment. (GM)	
7.	For specific cases students demonstrate their ability to understand and design cross-functional as well as cross-company business processes in a global context. (GPM)	Course provides an introduction to Business Administration, Marketing, Advertising courses Sustainability which the students will have attended
7.	Students show that they are able to apply their international management and engineering competencies in specific situations. (IM)	The team presentation (including international students) of a topic have to be organized and also an interactive workshop with the other participated students

Teaching and learning approach:

During the lecture, a student project from the five topics (see overview) covered in the lecture is assigned. Each team consists of at least three students. The results of this project must be scientifically documented and written down in detail. Each person should be responsible for the content of 10 pages of the report. After completion of the written report, a half-hour discussion on the report will take place. The concept of learning combines interactive and independent learning with teamwork.
The teacher is always available to give feedback, support and advice. Communication takes place via e-mail or web-conference.

Final Examination:

No Final written Exam

The written report (10 pages per team member) is due by the 15.12.2020. The written report should be made uniform and formally follow all the guidelines of a bachelor thesis.

The written report, the discussion about it and the active participation during the lecture will be evaluated as follows:

Active participation during the lecture	30%
Written report by the end of the semester	60%
Presentation and discussion about the report	10%

If a student wants a separate grade, a separate grade for each Team member will be given!

My teaching philosophy:

The contribution of the lecture is to understand the interdependencies of globalization, sustainable development and technical requirements of an international directed energy management. Due to different learning methods (lecture, simulation, presentations, workshops, dynamic interaction within the group) I want to design an interesting and diversified course, which helps to find the right way in the working environment. Your comments and contributions are welcome to serve the knowledge of all. My goal is that you can finish the course successfully, but the main part of the work is yours.

My expectation for students:

- Read Syllabus
- Pay attention and involve yourself in the discussion
- Ask questions
- Do not disturb the lecture, by conversation with your neighbors, eating or drinking
- Arrive on time to the lecture and do not leave earlier

Course Schedule

07.10.2020 15.30–17.00	**I. Introductory meeting** - Presenting and discussing the topics, topics assignment to each team of students,
14.10.2020 15.30–18.45	**II. System approach: Energy and Resource Efficiency** – Basic principles; What are drivers for them? How it will be measured?
21.10.2020 15.30–18.45	**III. Energy - From a global perspective to applications in industry**
28.10.2020 15.30–18.45	**IV. Energy transition in Germany** (Team 1)
04.11.2020 15.30–18.45	**V. Phase out of Coal Power Supply in Germany** (Team 2)
11.11.2020 15.30–18.45	**VI. Energy efficient Production and use of Goods** (Team 3)
18.11.2020 15.30–18.45	**VII. Lightweight design as a driver of innovation: improving energy efficiency and emissions of GHG** (Team 4)
25.11.2020 15.30–18.45	**VIII. Innovative techniques in production, distribution or transport of energy** (Team 5)